

Energy Technologies Area

Lawrence Berkeley National Laboratory

EPA's Clean Power Plan With a Focus on Energy Efficiency and EM&V

Steven R. Schiller, Senior Advisor/Affiliate
Lawrence Berkeley National Laboratory
http://emp.lbl.gov
srschiller@lbl.gov

Presentation Hosted By:
Western Renewable Energy Generation Information
System (WREGIS)
Western Electricity Coordinating Council (WECC)



Agenda



- Presentation a basic introduction to the following:
 - Clean Power Plan (CPP)
 - End-use energy efficiency
 - Evaluation, measurement and verification (EM&V)
 - EM&V and tracking in the CPP
- Participant Q&A

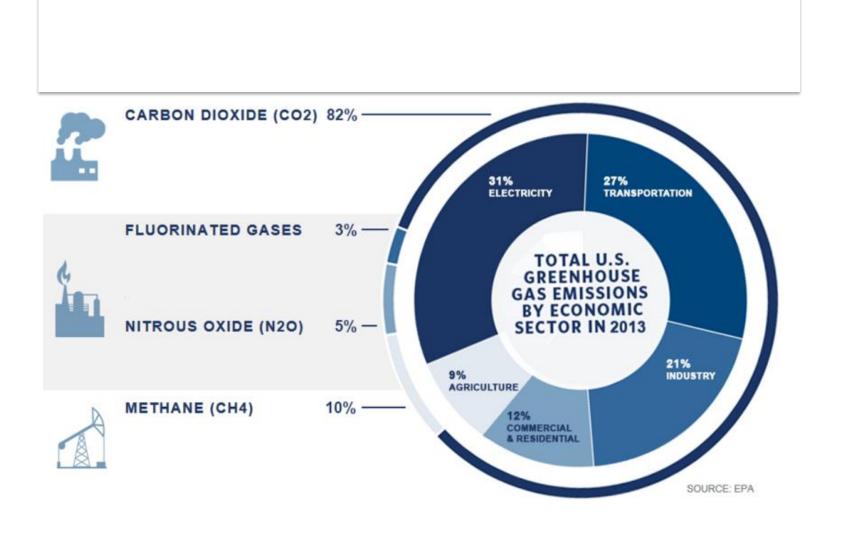
Disclaimers



- This presentation and any comments or opinions expressed are those of the presenter and NOT those of the WECC, WREGIS, WIEB, US E.P.A., US D.O.E., or LBNL
- With respect to the CPP, with over 3,000 pages of related documents, this is an <u>initial</u> summary and interpretation.....

Context – power plants are the single largest source of carbon pollution





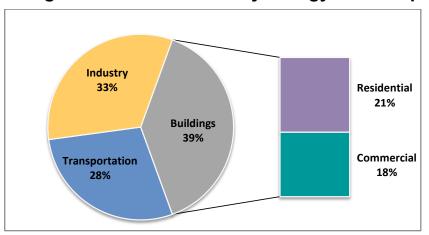
Context – industry and buildings represent about 3/4 of U.S. energy consumption



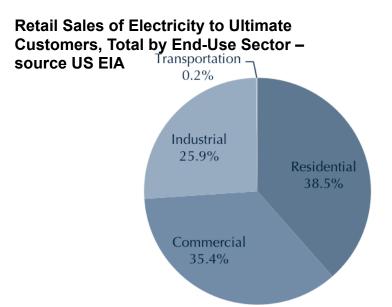
And industry and buildings are where end-use electricity efficiency happens

- Residential and commercial buildings account for about 70% of total U.S. electricity consumption and about 40% of U.S. carbon dioxide (CO₂) emissions.
- Nearly all of the greenhouse gas (GHG) emissions from the residential and commercial sectors can be attributed to energy use in buildings
- About 25% of electricity goes to industry where efficiency can be quite cost-effective

Buildings Share of U.S. Primary Energy Consumption



Source: U.S. Department of Energy (DOE), 2008 Buildings Energy Data Book, Section 1.1.1, 2008.





CPP Basics



CPP Introduced by President Obama on August 3, 2015



EPA took three actions intended to significantly reduce carbon pollution from power sector:

- Clean Power Plan (CPP) existing sources
- Carbon Pollution Standards new, modified and reconstructed sources
- Federal Plan proposal and model rule



CPP Goal Setting: BSER and Building Blocks



- EPA established CO₂ emission performance rates representing the Best System of Emission Reduction (BSER) for existing fossil fuelfired EGUs
- EPA has established a BSER, in three building blocks

Block 1 - Increase efficiency at EGUs

Block 2 – Shift to less carbonemitting sources (NG EGUs)

Block 3 - Shifting generation to clean energy renewables

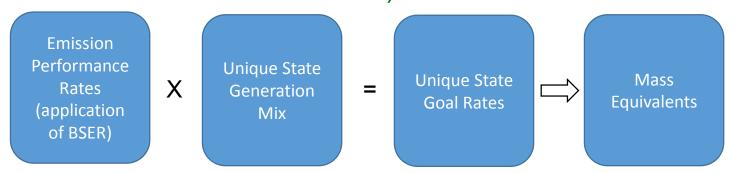
EGU Performance Emission Rate (lbs/ MWh)

- The building blocks a tool for setting state goals
 - Yes, demand side EE was not used to set goals in final CPP
 - However, states are free to meet goal in the way that works best for them
 - States can rely more or less heavily on specific measures such as demand side efficiency or renewable energy

CO₂ Emission Goals

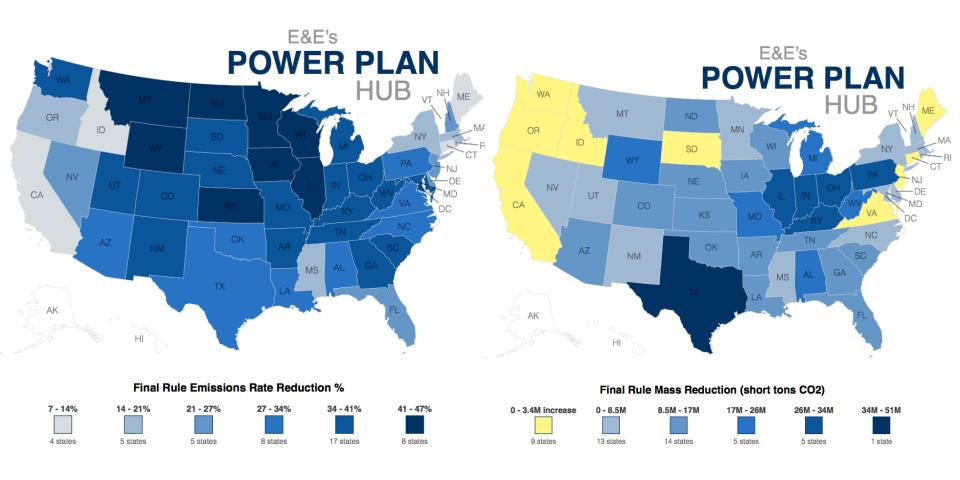


- Power plants are subject to the same standards no matter where they are located
- EGU emission performance rates have been translated into equivalent state goals
- EPA provided state goals in three forms:
 - Rate-based goal measured in pounds per megawatt hour (lb CO₂/ MWh)
 - Mass-based goal measured in short tons of CO₂
 - Mass-based goal with a new source complement (for states that choose to include new sources)



State by State CO₂ Goals - graphics from E&E Publishing





Graphics accessed on 8/11/15 from http://www.eenews.net/interactive/clean_power_plan#updated_mass_reduction

CPP Timeline — slide from U.S. EPA



Summer 2015

• August 3, 2015 - Final Clean Power Plan

1 Year

 September 6, 2016 – States make initial submittal with extension request or submit Final Plan

3 Years

 September 6, 2018 - States with extensions submit Final Plan

7 Years

• January 1, 2022 - Compliance period begins

15 Years

January 1, 2030 - CO₂ Emission Goals met

- Interim CO performance rates between 2022 and 2029
- Final CO emission performance rates by 2030

Plan Types and Approaches



- States pick a mass- or rate-based goal approach
- States submit a "State Plan" for affected EGUs to implement interim and final goals (or the federal plan is implemented)
- Two State Plan types:
 - Emission standards plan includes source-specific requirements ensuring all affected EGUS meet their goals
 - o rate-based goal approach or
 - mass-based goal approach
 - State measures plan

 includes a mixture of measures
 implemented by the state, such as renewable energy standards and efficiency programs
 - Mass-based goal approach only

Many CO₂ Reduction Opportunities



- Heat rate improvements
- Fuel switching to a lower carbon content fuel
- Integration of renewable energy into EGU operations
- Combined heat and power
- Qualified biomass co-firing and repowering
- Renewable energy (new & capacity uprates) wind, solar, hydro
- Nuclear generation (new & capacity uprates)
- Electricity transmission and distribution improvements
- Carbon capture and utilization/sequestration for existing sources
- Demand-side energy efficiency measures, programs and policies –

Energy efficiency improvements are expected to be an important part of state compliance across the country and under all state plan types, providing energy savings that reduce emissions, lower electric bills, and lead to positive investments and job creation

Energy Efficiency Strongly Supported in CPP



CPP encourages states to select energy efficiency as a compliance path

- Under a mass-based approach, energy efficiency automatically "counts" toward compliance and states can use an unlimited amount to help achieve their state goals
- Under a rate-based approach, CPP enables states to get credit for all eligible energy efficiency projects whose electricity savings are documented via EM&V
- The Clean Energy Incentive Program (CEIP) provides additional incentives for early investment in demand-side energy efficiency in lowincome communities

Early Investments - slide excerpts from U.S. EPA



- EPA is providing the Clean Energy Incentive Program (CEIP) to incentivize early investments that generate wind and solar power or reduce end-use energy demand during 2020 and 2021
- The CEIP is an optional, "matching fund" program states may choose to use to incentivize early investments in wind or solar power, as well as demand-side energy efficiency measures that are implemented in low-income communities
- EPA will provide matching allowances or Emission Rate Credits (ERCs) to states that participate in the CEIP, up to an amount equal to the equivalent of 300 million short tons of CO2 emissions. The match is larger for low-income EE projects, targeted at removing historic barriers to deployment of these measures. Also, states with more challenging emissions reduction targets will have access to a proportionately larger share of the match
- In addition to the CEIP, states may also offer credit for early investments in RE and demand-side EE according to the provisions of section VIII.K.1 of this final rule: a state may award ERCs to qualified providers that implement projects from 2013 onward that realize quantified and verified MWh results in 2022 and subsequent years.

Energy Efficiency in the CPP – Rate-Based Approach



- EE can be used to generate Emission Rate Credits (ERCs) that are used to help meet the rate target
- Rate based approaches are where there are significant CPP EM&V and tracking requirements for EE

```
CPP Emissions Rate =
```

(Affected EGU Emissions, Ibs/year)

(Affected EGU Generation, MWh/year) + (ERCs, MWh/year)

Example:

- Emission = 1,000,000 lbs/year
- Generation = 1,000 MWh/year
- Emission rate = 1,000 lbs/MWh
- Target = 800 lbs/MWh
- ERCs required = 250 MWh/yr CPP Rate = 800 lbs/MWh

Energy Efficiency in the CPP – Rate Based Approach (continued)



- Reminder: Only emission standard plans use rate-based approaches (not state measure plans)
- In proposed federal plan there are no end-use efficiency ERCs

Some detail from CPP:

"..a state may implement a market-based emission trading program, which enables EGUs to generate and procure [Emission Rate Credits] ERCs, a tradable compliance unit representing one MWh of electric generation (or reduced electricity use) with zero associated CO₂ emissions."

"...These ERCs may then be used to adjust the reported CO₂ emission rate of an affected EGU when demonstrating compliance with a rate-based emission standard. For each submitted ERC, one MWh is added to the denominator of the reported CO₂ emission rate, resulting in a lower adjusted CO₂ emission rate."

Eligible EE for Adjusting CO₂ Emission Rates Rate Based Approach



- Broadly speaking all actions must be quantifiable, verifiable, enforceable, non- duplicative and permanent
- "Demand-side EE may include a range of eligible measures, provided that the measures can be quantified and verified in accordance with the EM&V requirements in the emission guidelines..."
- Will provide examples of demand-side EE measures in the next portion of this presentation

Energy Efficiency in the CPP – Mass-Based Approach



- EE reduces emissions mass "indirectly".
- EE EM&V is less of an issue with mass-based approach, but:
 - EE is implemented with complementary programs, which should have their own EM&V plans
 - CEIP (early investments) requires EM&V

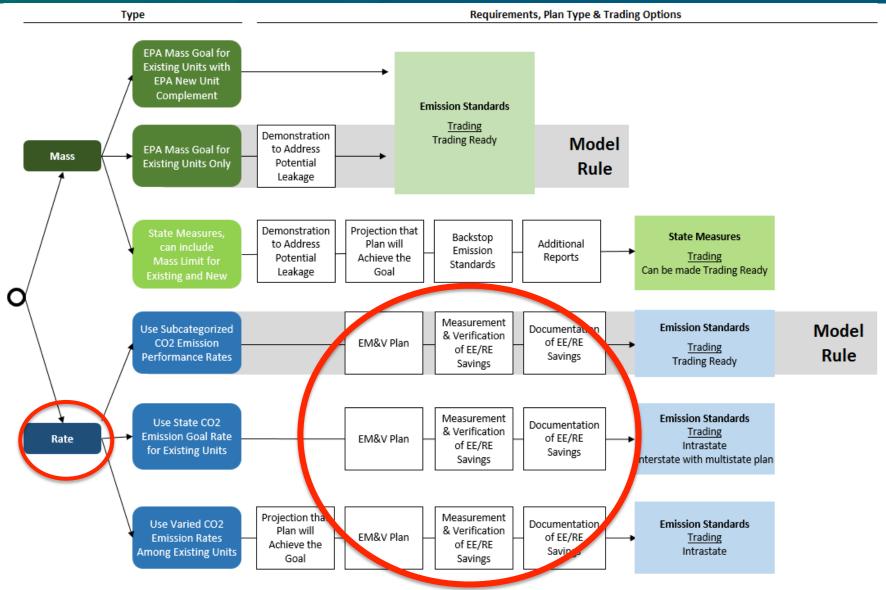
From CPP:

- "....incentivizes the use of strategies such as RE and demand-side EE as complementary measures that reduce CO₂ emissions."
- "The EPA believes the state measures plan type will provide states with additional latitude in accommodating existing or planned [EE] programs ".... unlike under a rate-based approach, for this latter set of measures there is no need to address and describe these state measures in a state plan submission or quantify and verify ...EE MWh of ... savings..."
- Reminder: State measure plans are "mass plans", emission standard plans can also be "mass plans"

Summary: Several Pathways for States -



slide from U.S. EPA





Energy Efficiency Basics



Historical Context



Who wore this sweater on February 2, 1977?



Jimmy Carter (2 weeks after becoming President)



 "One of our most urgent projects is to develop a national energy policy. Our program will emphasize conservation."

 "All of us must learn to waste less energy."



What is Efficiency



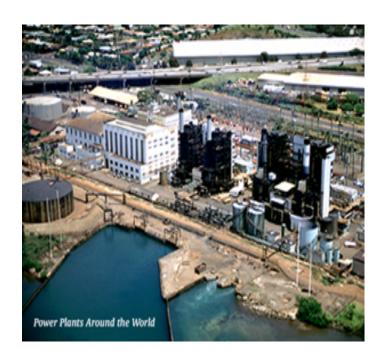
- Energy Conservation: Doing with less of a service in order to save energy:
 - Using less energy and probably getting less output/service quality
 - Example: Turning up the thermostat to get less cooling
- Energy Efficiency: The use of less energy to provide the same or an improved level of output or service to the energy consumer in an economically efficient way:
 - Using less energy to perform the same function
 - Example: A more efficient air conditioner
- Turning street lights off versus installing efficient street light lamps and controls



Why is Efficiency Important

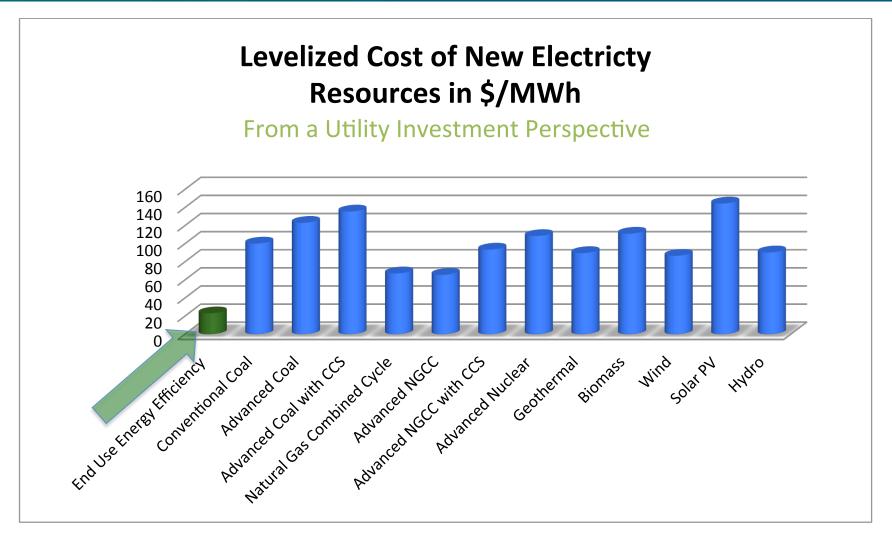


- Cost savings
- Reliability improvement
- Environmental Impact Mitigation



BERKELEY LAB

Why Efficiency: Costs - Its Relatively Cheap



Why Efficiency: Increases Reliability



- Less demand = less GT&D and fuel
- Can be targeted, modular, and quickly implemented
- Capacity & electricity reliability benefits, and supports renewable integration
- Bottom line if your boat sank, would you rather swim
 1 mile or ½ mile to shore



Why Energy Efficiency: Multi-Pollutant Reductions



- End-use efficiency reduces emissions by avoiding the need to generate electricity in the first place
- Energy efficiency is included as a top measure to meet the reduction goals of state GHG mitigation plans.
 - Of the approximately 30 state-level climate change action plans that have been completed since 2000, efficiency programs were in the "top 10" GHG reduction measures and in many cases were among the top five measures
- Of course all types of power plant-related emissions are reduced:

Health and Welfare Impacts of Air Pollutants and Energy Efficiency Reduction Potential

Pollutant	Climate Forcer	Acidifying Substance	Eutrophying Substance	Ozone Precursor	Particulate Matter or Precursor	Can Be Reduced Through Energy Efficiency
Ammonia (NH ₃)		Х	Х		Х	Х
Carbon Dioxide (CO ₂)	Х	Х				Х
Carbon Monoxide (CO)	Х			Х		Х
Heavy Metals (HM)					Х	Х
Methane (CH ₄)	Х			X		X
Nitrogen Oxides (NO _x)	Χ	X	X	X	X	X
Non-Methane Volatile Organic Compounds (NMVOC)	Х			x	х	Х
Primary Particulate Matter (PM)	Х				Х	Х
Polycyclic Aromatic Hydrocarbons (PAH)					х	Х
Sulfur Dioxide (SO ₂)	Х	Х			Х	Х

Table Source: SEE
Action Guide for States:
Energy Efficiency as a
Least-Cost Strategy to
Reduce Greenhouse Gas
Emissions and Meet
Energy Needs in the
Power Sector
(forthcoming)"

Efficiency is an Established Resource

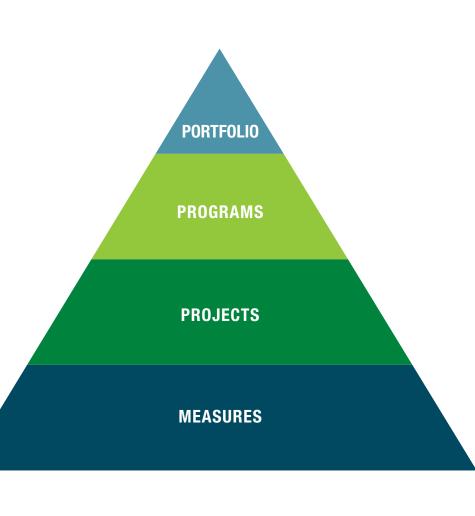


- Energy efficiency programs have been in place in the U.S.
 for several decades, and every state has programs in place
- Many utilities recognize energy efficiency as a resource in the resource plans they develop to guide investment decisions and operational plans
- Nevertheless, there is significant (and 'renewing') untapped energy efficiency potential

The Savings Hierarchy



- Measures are the fundamental savings units equipment or strategy
- Projects are coordinated activities to install one or more measures at a facility
- Programs are collections of similar projects that are intended for a specific market (designed and administered by a single entity – e.g., a utility)
- Portfolios are multiple
 program initiatives in specific
 market sectors (again,
 typically administered by a
 single entity such as a utility_



Options: New Construction and Retrofits



 New Construction – more efficient than what would have been built

- Retrofits two kinds of measures:
 - Replace on burnout = replace equipment when existing equipment fails
 - Early replacement = replace equipment before the end of the useful life of existing equipment

Actually There are a lot of options



Funding	Lead Entity	Time Frame
 Utility customers Public/General funds Cap and Trade Auction Funds Consumers Industry 	 Local and state agencies Federal Entities Utilities Non-profits Industry collaboratives 	 Short Term – Quick Start Medium term Long Term
Market Segments/ Sectors	Objectives	Implementation Strategies
 Market Segments Upstream Mid-stream Down stream Market Sectors Commercial Residential and Multi-Family Low Income Agricultural 	 Market transformation Resource Acquisition Pilots Infrastructure development 	 Voluntary Direct Install Incentives Financing Mandatory Codes Standards

Broad categories of efficiency programs:



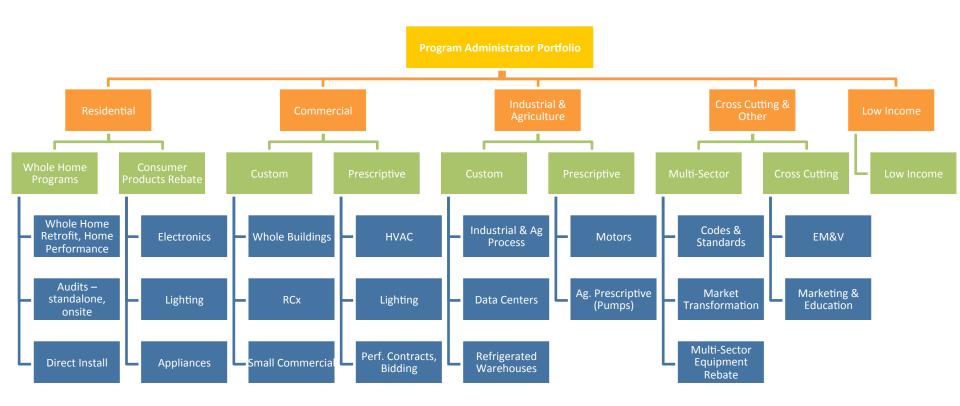
Utility Programs

- Utility programs use utility customer funds to support efficiency actions
- Who does: Overseen by a regulatory board (e.g., PUC) or public or coop utility board, administered by utilities or other entities, and implemented by range of contractors and consumers
- Project types: retrofit or new construction for residential, commercial, agricultural, industrial, public, etc., market sectors
- Can include:
 - Direct action programs rebates and incentives, direct installation, technical assistance for applications such as:
 - Whole house retrofits including low income tenant projects
 - Street lighting
 - Indirect action programs consumer behavior programs, marketing education and outreach programs, workforce education and training programs, financing programs, and energy audit programs

Energy Efficiency Utility Programs



Examples of common utility program types (and support activities)



Source: Hoffman, I., M. Billingsley, S. Schiller, C. Goldman, and E. Stuart. (August 28, 2013). "Energy Efficiency Program Typology and Data Metrics: Enabling Multi-State Analyses Through the Use of Common Terminology." Lawrence Berkeley National Laboratory, Clean Energy Program Policy Brief. LBNL-6370E. http://emp.lbl.gov/sites/all/files/lbnl-6370e.pdf

Broad categories of efficiency programs:



Performance Contracting

- Performance contracting involves tying, in some manner, contractor payments to the achieved energy savings
- Who does: Performance contracts are implemented by Energy Service Companies (ESCOs)
- Project types: mostly public agency (schools, hospitals, municipal buildings) and large commercial/industrial projects; most projects are "comprehensive" retrofits
 - A typical performance contract reduces annual energy use by 15 percent to 30 percent
 - Electricity accounts for an estimated two-thirds of the energy savings for public and institutional (e.g., universities and hospitals)
 ESPC projects

Broad categories of efficiency programs:



Codes and Standards

Codes

- Building energy codes are legal energy-efficiency requirements that apply to the design and construction of buildings
- Energy codes are adopted by state or local governments and govern design and construction of new residential and commercial structures in their jurisdictions, as well as in some cases the retrofitting of existing structures
- Efforts can involve advancing stringency of codes and improving compliance with existing codes

Standards

- Product energy standards are legal energy-efficiency requirements that specify the minimum efficiency levels of specific products
- Federal standards currently apply to about 55 categories of appliances and equipment sold in the U.S.
- For products that are not subject to existing national standards (and thus not subject to federal pre-emption) states may adopt their own product standards for sales within their borders

Broad categories of efficiency programs:



Other Types of Projects and Programs

- Combined heat and power
- Distribution system improvements e.g., conservation voltage reduction
- Water conservation/energy efficiency combination projects
- Financing programs
- Low income/disadvantaged community programs

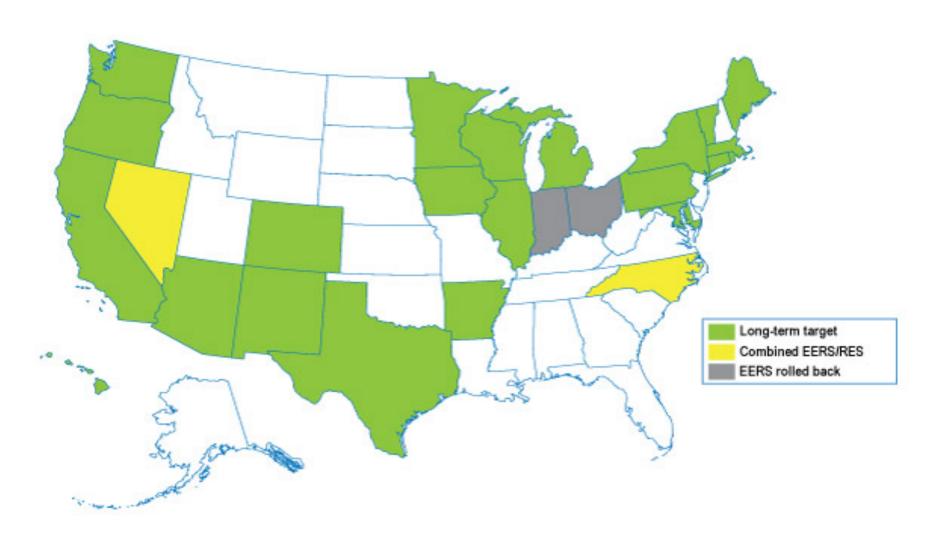
Efficiency Status Across the Country



The next few slides will be quickly reviewed to provide a sense of the growth of efficiency activity in the U.S.

Half of States Have Energy Savings Targets



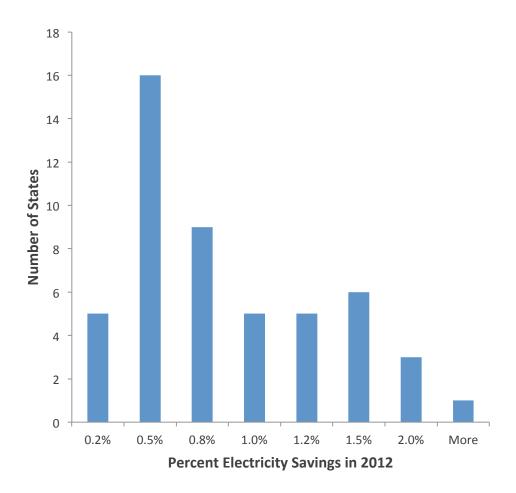


Source: ACEEE, www.aceee.org accessed 9/11/15

Estimated Achieved Annual Electricity Savings Rising Among States



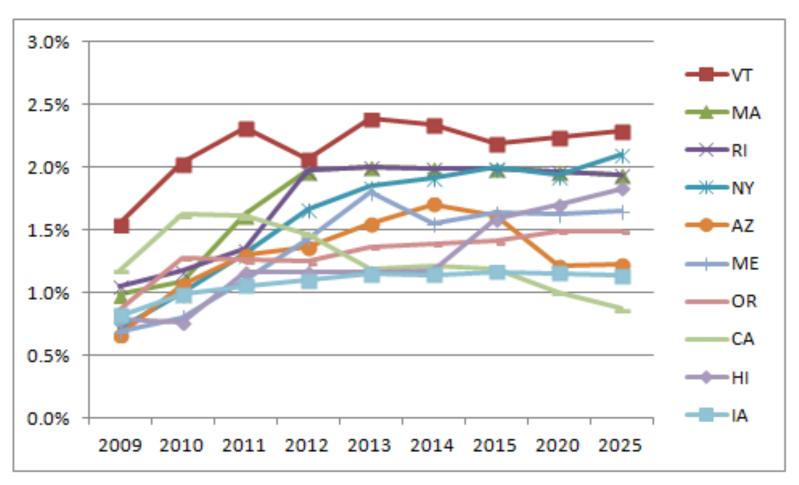
- ➤ 30% of states achieving 1% or higher annual incremental electricity savings
- ➤ Many "new" states about 40% are saving 0.2% to 0.7%
 - ➤ Given the prevalence of rising targets, most of these states are poised for higher savings



Source: Barbose et al. "The Future of Utility Customer-Funded Energy Efficiency Programs in the United States: Projected Spending and Savings to 2025" LBNL-5803E. 2013

Most Leading States Projected to Save 1.5% or More

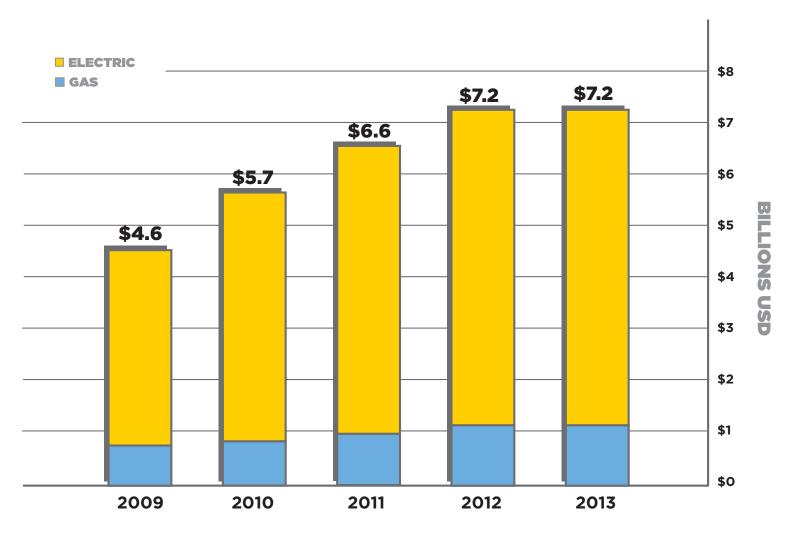




Source: Barbose et al. "The Future of Utility Customer-Funded Energy Efficiency Programs in the United States: Projected Spending and Savings to 2025" LBNL-5803E. 2013

Growth in Total Electric (and natural gas) Demand Side Management Spending

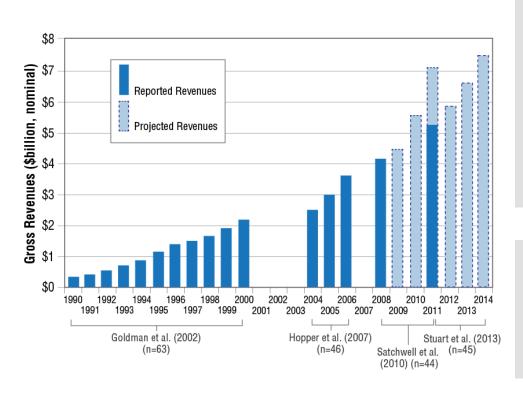




2014 State of the Efficiency Program Industry: Budgets, Expenditures, and Impacts, Consortium for Energy Efficiency, 201

ESCO Industry Growth

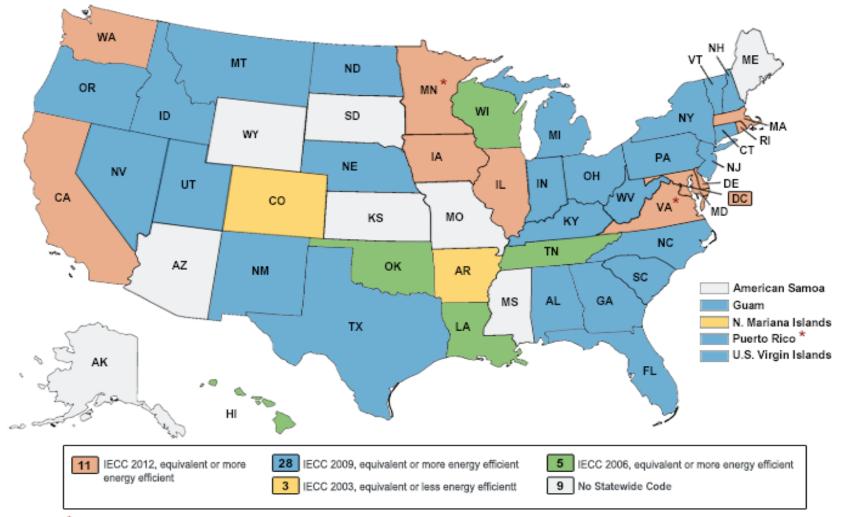




- The industry reported revenues of about \$5.3 billion in 2011, with estimated 2013 revenues of about \$6.4 billion. Still, the remaining investment potential in public and institutional facilities is large, estimated at about \$71 billion to \$133 billion LBNL, Stuart et.al 2013
- LBNL projects that the ESCO industry will grow from ~\$4 billion (2008) to \$7.5 billion (2014).

More Than Two-Thirds of States Have Adopted 2009 or Later Residential Codes





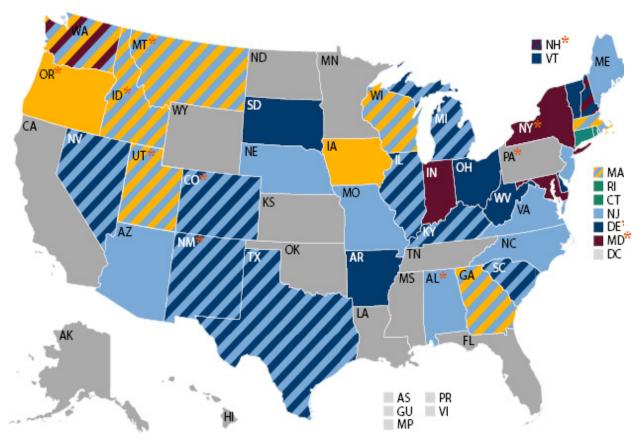
* Adopted new Code to be effective at a later date

As of December 2014

Source: DOE Building Energy Codes Program, December 2014, http://www.energycodes.gov/status-state-energy-code-adoption

Nearly 75% of States Are Engaged in Some Form of Compliance Enhancement





Source: BCAP

- BCAP Compliance Planning Assistance
 In completing the Compliance Planning Assistance
 (CPA) Program, BCAP will identify the gaps in code
 implementation in 15 states, and help complete a
 roadmap of reachable goals to improve compliance.
- DOE Code Adoption, Training, Compliance
 States that have received a funding contract from the
 U.S. Department of Energy to support activities to adopt
 and implement the U.S. model energy codes.

■ State Projects

These states have organized their own programs to improve compliance with the 2009 IECC, and will be tracking compliance with the code on their own.

DOE Compliance Pilot Studies

The U.S. Department of Energy has begun tracking compliance with the 2009 IECC in select states that have already adopted the code, and will publish usable best practices for compliance for any state.

Regional Energy Efficiency Group Projects These states are taking part in compliance programs and studies organized by their respective regional group: NEEP, SEEA, MEEA, NEEA, and SWEEP.

* Recent Model Code Training

States that have recently provided training on new codes equivalent to or more stringent than the 2009 IECC or ASHRAE Standard 90.1-2007.

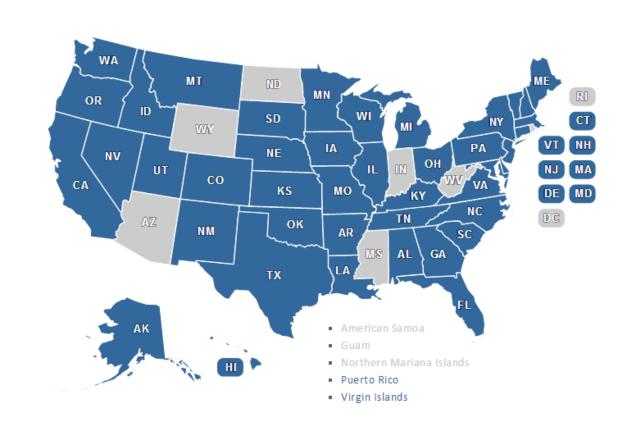
Revolving Loan Funds and Loan Loss Reserves Prevalent in Most States



NASEO SELF database

NASEO has tracked a total of 79 programs in 44 states, representing a total of over \$2 billion in available state financing for energy efficiency and renewable energy projects in a variety of sectors.

LBNL's forthcoming paper on ARRA-funded RLFs and LLRs, a collaboration with NASEO, will add to understanding of RLF and LLR programs.

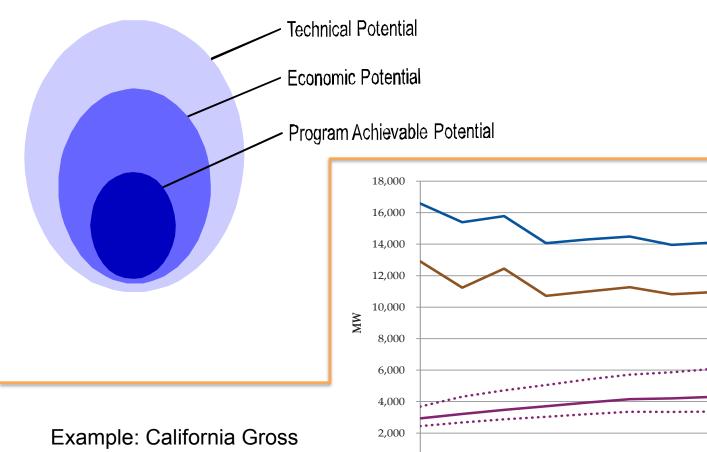


Source: NASEO SELF database

Understanding the potential of efficiency



- how efficiency potential is determined



2015

· · · · · High Cumulative Market Potential

Technical Potential

2016

Economic Potential

Mid Cumulative Market Potential Low Cumulative Market Potential

Example: California Gross Technical, Economic, and Cumulative Market Demand Savings – Potential for 2012-2024 (MW)

High level sense of efficiency's potential



It depends, but

Codes and Standards

 Savings from Codes and Standards have each grown from essentially zero to about 1% of national electricity sales in 2012 and growing

Utility efficiency programs

- Grown from very small impacts in the 1980s to about 0.5% annual decreases in electricity consumption nationally
- Based on current state policies, savings from these programs could reach 0.8% to 1.1% per year of national electricity sales by 2025
- Using broad generalization efficiency can probably save, costeffectively, at least 1% to 2% (some say 3%) of electricity sales each year
- For comparison, EIA's 2012 reference case projects that U.S. electric retail sales will grow by 0.58% annually through 2025

Summary: end use efficiency is good stuff



Sure....it reduces waste and saves consumers money in the long run, improves reliability and has environmental benefits (including reduced water use), but also -

- Anybody and everybody can participate
- Local economic development, jobs



- It's cheap
- It has already saved a lot
- There are plenty of opportunities – there are new technologies and approaches – it is not a limited resource

So What Is The Problem?

Barriers to Energy Efficiency

Or – How many people does it take to screw in a LED?





Efficiency's Version of the Tragedy of the Commons

efficiency is a great costeffective mechanism for society to save energy and reduce emissions, but... there is a paradox

It is not necessarily the choice that individual energy users make because of various market barriers

Thus, intervention is required to meet full potential of efficiency

Barriers and Opportunities



Barriers

- Front-end investment requirements
- Principal agent problem (property owner/tenant)
- Lack of information
- Transaction costs
- Lack of knowledgeable contractors, suppliers, etc.
- Uncertainty in documenting benefits

Opportunities

- Utility programs
- Codes and Standards
- Performance contracting
- Distribution efficiency
- Etc.
- Etc.





EM&V Basics



EM&V Definitions



- Evaluation The performance of studies and activities aimed at determining the effects of a program or portfolio
- Measurement and Verification Data collection, monitoring, and analysis associated with the calculation of gross energy and demand savings from individual sites or projects. M&V can be a subset of program evaluation.
- EM&V The term "evaluation, measurement, and verification" is frequently seen in efficiency evaluation literature. EM&V is a catchall acronym for determining both program and project impacts.

Evaluation Categories



- Impact evaluations assessments that determine and document the direct and indirect benefits of an energy efficiency program. This is what we are focusing on for CPP compliance - determining energy savings
- Process evaluations formative, systematic assessments of an energy efficiency program. They document program operations and identify and recommend improvements.
- Market evaluations assessments of structure or functioning of a market; include estimates of the current market role of energy efficiency (market baselines) and potential (potential studies).

Impact Evaluation Metrics

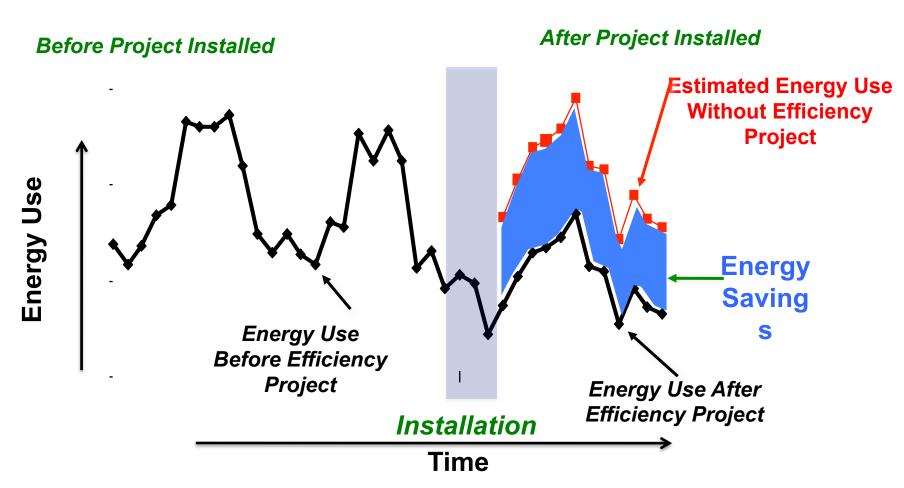


- Gross Savings: The change in energy consumption and/or demand that results directly from program-promoted actions taken by program participants regardless of the extent or nature of program influence on their actions.
- Net Savings: Refers to the portion of gross savings that is attributable to the program. Attributing changes to one cause (i.e., a particular program) or another can be quite complex.
- Non-Energy Benefits: Impacts associated with program implementation or participation. Can be positive or negative. Some examples include: avoided emissions and environmental benefits, productivity improvements, jobs created and local economic development, reduced utility customer disconnects, higher comfort and convenience.



Savings Cannot Be Measured -

they are estimated against a baseline



Graph of Energy Consumption Before, During And After Project Is Installed

Baseline



- Baseline definition: conditions (including electricity consumption) that would have existed without implementation of the subject EE activity.
- Baseline is used to estimate measure-, project- and program-related savings.
- The key challenge with quantifying EE savings is the identification of an accurate baseline from which to determine energy savings

Isolating Effects of Efficiency vs. Other Factors that Affect Consumption



Individual Buildings

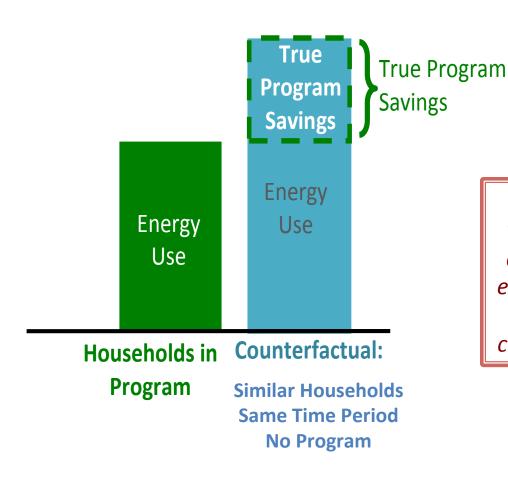
- Changes in the building (e.g., renovation)
- Changes in the household (e.g., new baby)
- Changes in business activities (e.g., number of employees, evolving industrial processes, operating hours, etc.)
- Changes in appliances/ equipment apart from the program

Broader Issues

- Weather
- Economy
- Changing codes/standards and common practice
- Energy prices
- Other Programs

Looking at same issue from a program perspective: counterfactuals





Counterfactual analysis occurs when a person modifies a factual antecedent (a thing or event that existed before or logically precedes another) and then assesses the consequences of that modification.

Two Components to Impact Evaluation:



- 1. Verify potential to generate savings
 - 2. Determine savings

Example: Lighting Retrofit Example: New Car

Potential to Save:

Before: 60 Watts/fixture

After: 13 Watts/fixture

Savings:

Savings determined based on operating hours and lifetime of lamps

Potential to Save:

Before: 10 MPG

After: 50 MPG

Savings:

Savings determined based on how many miles driven and for how many years



Approaches for Determining Gross Energy Savings



- Apply deemed (stipulated, default) values or calculations that are based on historical and verified data to projects and/or measures with correct applicability conditions. Typically applied to "prescriptive" or "standard" measures.
- Conduct Statistical analyses of large volumes of metered energy usage data. Typically applied to "mass market" and "residential" programs and with a control group versus a participant group.
- One or more measurement and verification (M&V) options from the IPMVP* (A, B, C and/or D) are used to determine the savings from a sample of projects. These savings are then applied to all of the projects in the program. Typically applied to "custom" measures.

*International Performance Measurement and Verification Protocol

Deemed Savings



- Deemed (stipulated) savings are used to define savings values for projects with well-known and documented savings values in defined applications.
- The use of deemed values in a savings calculation is an agreement to accept a pre-determined value, irrespective of what actually "happens."
- Deemed values and deemed calculation approaches are often documented in a "Technical Reference Manual" – the Northwest's "RTF" is an example as is California's "DEER"

Statistical Data Analysis



- Large-scale data analysis applies a variety of statistical methods to measured facility energy consumption meter data (almost always whole-facility utility meter billing data) and independent variable data to estimate gross energy and demand impacts.
- Most large-scale data analyses involve the use of comparison groups. The control group can be either:
 - Program nonparticipants, as is the case with randomized controlled trials
 - Participants, as is the case with some quasi-experimental methods

Measurement and Verification



Determining gross savings by:

- Determining the savings of each project in a program, or
- Selecting a representative sample of projects

Then:

- Determining the savings of each project in the sample, using one or more M&V Options that all involve some form of measurements
- Applying the sample projects' savings to the entire population, i.e., the program

Verification

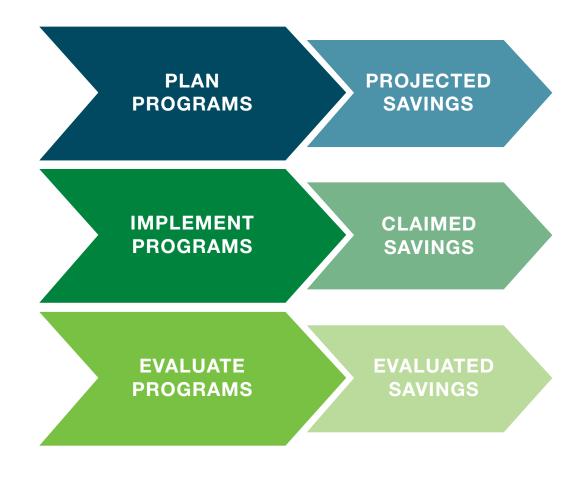


Recall that there are two parts to EM&V: (1) determining potential for savings and (2) determining actual savings

- Usually some physical assessment of at least a sample of the individual projects is done
- Ensures that the measures installed are to specification and thus have the potential to save
- Potential to generate savings can be verified through observation, inspections, and spot or short-term metering conducted immediately before and after installation.
- Sometimes, all you need is verification and the use of a deemed savings value

Planning, Implementing, and Evaluating Efficiency Programs

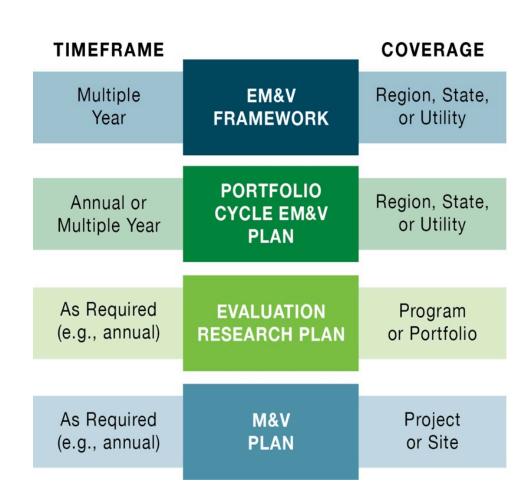




Structure for Defining Evaluation Activities



- <u>EM&V Framework</u> —Primary document that lays out top level structure. This is perhaps the principal document that all stakeholders can focus on and provide high level input.
- Annual Plans Indicates major evaluation activities that will be conducted during the evaluation cycle
- Evaluation Program Plans –
 Created for the major EM&V activities
- Site Specific M&V Plans For custom project sites that are analyzed and inspected



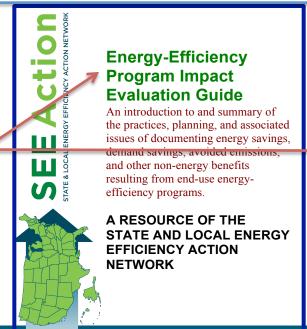
EM&V Resouces and Support

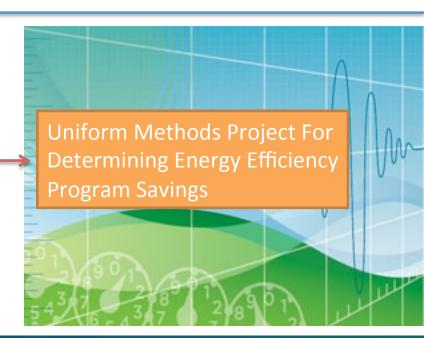


About 40 years of experience with EE EM&V

- An EM&V industry of professionals exist for example, see: <u>www.evo-world.org</u> and <u>www.iepec.org</u>
- Numerous state, national and international guidance documents and protocols exist – an excellent resource portal is at this website: https://www4.eere.energy.gov/seeaction/evaluation-measurement-and-verification-resource-portal

Two example resources – accessible via above indicated web portal







EE EM&V in the CPP



Energy Efficiency EM&V in the CPP



- For the CPP, EM&V is associated with successfully quantifying and verifying savings for purposes of generating emission rate credits (ERCs) and adjusting an emission rate
- EM&V is described in three documents:
 - Requirements
 CPP Emissions Guidelines see Section VIII.K
 - Presumptively approvable EM&V approaches
 Proposed model trading rule see Section IV.D.8.
 - Applicable guidance
 EM&V Guidance for Demand-Side EE

EM&V Requirements



Emissions Guidelines (EG) requirements are general and relatively limited, including (see EG for complete list and description):

- State plan would include EM&V plan for quantifying and verifying electricity savings on a retrospective (ex-post) basis using industry best-practice EM&V protocols and methods that yield accurate and reliable measurements of electricity savings.
- Assessment of the independent factors that influence the electricity savings and the expected life of the savings
- Baseline that represents what would have happened in the absence of the demand-side EE activity
- Periodic M&V reports
- Skill certification is also discussed

EM&V Guidance and Model Rule



Cover wide range of EM&V topics, including the following list from CPP EM&V Guidance document:

- EM&V Methods
- Electricity savings metrics and baselines
- Reporting timeframes and considerations
- Deemed savings
- Independent factors
- Accuracy and reliability
- Avoiding double counting
- Persistence of savings
- Savings quantification/verification cycles
- T&D savings adders
- Interactive effects
- EE EM&V Protocols and Guidelines

Also Covered in Guidance and/ or Model Rule:

- Tracking and compliance systems
- Independent verification and review
- Additional EM&V guidance for several common EE program and project types
 - Programs implemented using utility customer funds ("utility EE programs")
 - Individual or aggregated EE projects, such as those implemented by ESCOs or at industrial facilities
 - Building energy codes
 - Appliance energy standards
- Glossary of key terms
- Templates for program and project EM&V plans.
- Examples for several common measure types

Trading and Tracking – quick notes



- Trading is allowed, perhaps encouraged in the Rule
 - emission rate credits (for a rate-based standard) or
 - allowances (for a mass-based standard)
- Trading of ERCs, including EE ERCs under Rate Based Approach, can support CPP compliance:
 - Intra-state
 - Inter-state
- This requires implementing "systematic tracking and accounting procedures, including the use of well-structured and well-maintained tracking and reporting systems such as those already being used by many states and EE providers."

Registry Systems



- A tracking system or registry is required for trading of ERCs
 - Each ERC will need a unique identifier
 - ERCs must be "properly tracked from issuance to submission by affected EGUs for compliance to ensure they are only used once to meet a regulatory obligation."
- A particular issue for EE ERCs is the need for consistent EM&V requirements – thus protocols for the potential wide range of EE program and measure types should/must be developed
 - Thus, EE registries are perhaps more similar to GHG offset registries than REC registries, but still share a number of common characteristics with REC registries such as WREGIS
- EPA is exploring options for supporting national and regional trading/ tracking systems
 - Other groups are looking into this also, for example The Climate Registry and LBNL/DOE (eProject Builder)

Resources - CPP



- Clean Power Plan website:
 http://www2.epa.gov/carbon-pollution-standards
- Specific Documents:
 - CPP Emission Guidelines: http://www.epa.gov/airquality/cpp/cpp-final-rule.pdf
 - Federal Model Plan: http://www.epa.gov/airquality/cpp/cpp-proposed-federal-plan.pdf
 - EM&V Guideline: http://www2.epa.gov/cleanpowerplantoolbox/draft-evaluation-measurement-and-verification-guidance-demand-side-energy
- For additional resources to help states develop plans, visit the CPP Toolbox for States: http://www2.epa.gov/cleanpowerplantoolbox
- EPA Overview and energy efficiency presentations:
 http://www2.epa.gov/cleanpowerplan/clean-power-plan-overview-webinar
 http://www2.epa.gov/cleanpowerplan/fact-sheet-energy-efficiency-clean-power-plan

Efficiency Resources



- ACEEE American Council for Energy Efficiency Economy non-profit efficiency organization <u>www.aceee.org</u>
- Utility and other program administrator websites (e.g. Northwest Energy Efficiency Alliance – www.neaa.org)
- U.S. DOE Energy Efficiency Office http://energy.gov/eere/efficiency
- EPA/DOE State and Local Energy Efficiency Action Network (SEE Action)—
 - focuses on providing assistance states need to advance policies and practices that bring energy efficiency to scale.
 www.epa.gov/cleanenergy/energy-programs/seeaction/

EM&V Resources



- EPA/DOE State and Local Energy Efficiency Action Network (SEE Action)—
 - focuses on providing assistance states need to advance policies and practices that bring energy efficiency to scale.
 www.epa.gov/cleanenergy/energy-programs/seeaction/index.html
- The Northwest Regional Technical Forum
 - an advisory committee established to develop standards to verify and evaluate conservation savings. http://www.nwcouncil.org/rtf/about.htm
- Regional EM&V Forum (Northeast and Mid-Atlantic)
 - supports the development and use of common and/or consistent protocols to evaluate, measure, verify, and report the savings, costs, and emission impacts of energy efficiency. Covers 11 states. http://www.neep.org/emv-forum
- EVO
 - capacity building for M&V best practices <u>www.evo-world.org</u>

Thank you and time for discussion



Steve Schiller

Senior Advisor
Electricity Markets and Policy Group
Lawrence Berkeley National Laboratory
1.510.486.7780
srschiller@lbl.gov